Itus: An Implicit Authentication Framework for Android

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Why Implicit Authentication?
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1 out of 2 people don't have a passcode on their phone.
Why Implicit Authentication?
**Itus** is an implicit authentication (IA) framework for Android

**For app developers:**
- Add IA to existing apps by changing as few as two lines of code
- Get customized recommendations for IA schemes and configuration, based on the behaviour of the app
- Fine-tune parameters and behaviour using expert knowledge

**For IA researchers and developers:**
- Test proposals on real apps without constant re-engineering
- Easily extend Itus to include new machine learning algorithms, feature sets, parameterizations, etc.
- Able to distribute standalone extensions independently
App-specific functionality
For App Developers
Easy to use

```java
public class MainActivity extends SecureActivity
    implements IToolbarsContainer, OnTouchListener,
    IDownloadEventsListener {

    @Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        INSTANCE = this;
        /*create an Instance of Touchalytics classifier
         * & start the Itus thread*/
        (new Touchalytics()).start();
```
Configurable

```java
@override
public void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    INSTANCE = this;

    /*Configure & launch Itus*/
    Itus itus = new Itus(this);
    String [] featureList = {"Start X", "Start Y",
                             "Average Velocity", "Interstroke Time");
    Classifier svm = new SVMClassifier(
        featureList.length, "negative_instances");
    svm.setFeatureScaling(true);

    Measurement touch = new Touch();
    touch.setFeatureList(featureList);
    itus.useMeasurement(touch);
    itus.setTrainingSize(100);
    itus.useClassifier(svm);
    itus.start();
```
Customized
Customized
Customized
Customized
Customized
Architecture

- Android App
- Itus Library
- Itus Agent and Prefabs
- Machine Learning Toolkit
- Data Storage
- Event Processor and Feature Extractor
- SecureActivity
Prefabs

- Prefabs are pre-configured instances of the Itus Agent
- ...can specify classifiers, feature subsets, parameters, etc.
- ...allow an app developer to pick a prefab and go
Machine Learning Toolkit

- Contains **Classifier** objects, each implementing a single machine learning algorithm
- Developers implement only **train** and **classify** methods in order to add new algorithms
Event Processor

- Developers create **Measurement** classes (e.g. Touch, Keystroke, Movement)
- User input events are centrally managed and delivered by a Dispatcher object
- Measurement objects only need to process input data into a numeric feature vector
Performance

- Created three Itus Prefabs using different machine learning algorithms and feature sets
  - Touch-based, movement-based, and keystroke-based
- Added to two open-source Android apps
  - Zirco web browser and TextSecure SMS messenger
- Measured library overhead in terms of CPU, memory, and battery
CPU Overhead

![Graph showing CPU Overhead](image-url)

- **Zirco**
- **Zirco-Touchalytics**
- **Zirco-SilentSense**
- **TextSecure**
- **TextSecure-Keystroke**
Memory Overhead

The diagram shows a comparison of heap size (in kB) across different devices and applications. The y-axis represents the heap size, ranging from 0 to 800 kB. The x-axis is divided into two categories: Nexus and Zirco. Each category further divides into two subcategories: Nexus-1 and Nexus-4.

The bars represent different applications:
- **Zirco**
- **Zirco-Touchalytics**
- **Zirco-SilentSense**
- **TextSecure**
- **TextSecure-Keystroke**

The chart illustrates the memory overhead for each combination, indicating the relative performance and resource utilization across the specified applications and devices.
Also in the paper:

- Implementation details
- Detailed explanation of developer workflows
- More performance evaluation
  - Broken down by initialization, feature extraction, training, and classification
- Links to code repository
Itus is an application-level implicit authentication framework for Android that is:

- **easy** can be deployed by developers with minimal LoC
- **extensible** subcomponents can be improved iteratively
- **flexible** support for application-specific functionality
- **fast** minimal, *tuneable* performance overhead

https://crysp.uwaterloo.ca/software/itus/